UNIVERSITI SAINS MALAYSIA

First Semester Examination
Academic Session 2012/2013

January 2013

EBB 524/3 – Composite Materials

Duration : 3 hours

Please ensure that this examination paper contains FOUR printed pages before you begin the examination.

This paper consists of SEVEN questions.

Instruction: Answer **FIVE** questions. If candidate answers more than five questions only the first five questions answered in the answer script would be examined.

The answers to all questions must start on a new page.

All questions must be answered in English.

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1. [a] What are the **advantages** and **disadvantages** of using glass fibre, carbon fibre and aramid fibre to reinforced polymer composites?

(40 marks)

[b] Discuss the differences between:

(i) hybrid composites and laminar composites.

(ii) particle reinforced composites and fibre reinforced composites.

(30 marks)

[c] By using suitable diagrams, draw different **type of patterns** of fibre reinforcement in polymer composites.

(30 marks)

2. [a] For effective strengthening and stiffening of the polymer composites, the use of critical fibre length, l_c, fibre orientation and concentration of fibre are very important. Give your comments.

(30 marks)

[b] Discuss the results obtained in Table 1.

Table 1: Mechanical and Thermal Properties of Nylon-6-Clay Composites

Composite Type	**Wt (%) nanoclay**	**Tensile strength (MPa)**	**Tensile modulus (GPa)**	**Impact (kJ/m^2)**	**HDT (^oC) at 18.5 kg/cm^2**
Nanoscopic (Exfoliated)	4.2	107	2.1	2.8	145
Micro (tactoid)	5.0	61	1.0	2.2	89
Pristine Polymer	0	69	1.1	2.3	65

(30 marks)

[c] In a unidirectional carbon fibre/epoxy composites, the modular ratio is 40 and the fibres take up 50% of the cross-section. What percentage of the applied force is taken by the fibres?

(40 marks)

3. Due to the difference in properties of ceramic and metal, what would be the benefits which can be obtained by compositing ceramic and metal in a form of metal matrix composite? How does these differences cause difficulties in fabricating metal matrix composite product? Propose remedies or solutions to solve these difficulties.

(100 marks)

4. [a] Write down the 'law of mixtures' for composite. Define all the terms involved. What are the importances of this law? Comment on its experimental validity when this law is used to metal matrix composite that is prepared using in-situ approach. Name at least one system in your explanation.

(50 marks)

[b] What is a metal matrix composite? What is an alloy? Differentiate between metal matrix composite and alloy by considering their microstructures and properties. Name a suitable system for metal matrix composite and alloy to support your discussion.

(50 marks)

5. [a] Discuss about liquid infiltration technique in ceramic matrix composite fabrication. List the advantages and disadvantages of this process.

(50 marks)

[b] Describe the wake toughening. Give one example of material that has been used in this toughening mechanism.

(50 marks)

6. How the strong and weak interfacial bonding affect the CMC properties? Discuss your answer with the aid of illustration and example of CMC that use such bonding.

(100 marks)

7. [a] Discuss briefly the four (4) type of biodegradable polymers.

(40 marks)

[b] Give one example of metal matrix composite application. Describe what the properties requirement for this application is and how the metal matrix composite that you select does meet this requirement.

(30 marks)

[c] Describe the transformation toughening in toughening mechanisms.

(30 marks)

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